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Nanotechnology In Concrete Materials

This book focuses on the application of carbon nanotubes and carbon nanofibers in traditional concretes based on Portland cement. Fundamental information is given related to the production technologies of carbon nanotubes and carbon nanofibers, as well as concretes and methods of incorporation. It also contains a section focusing on the possible

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negative effects of carbon nanotubes and carbon nanofibers on animals and humans. The book indicates benefits and possible problems related to the application of carbon nanotubes and carbon nanofibers in concrete. It is designed to be easy to access and digest for the reader, aiming to reach an audience, not only from academia, but also from the construction industry, materials producers, and contractors who might work with

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nanomaterials. Outlines the major properties and synthesis methods for carbon nanomaterials in concrete engineering; Explains the role of carbon nanotubes and nanofibers in creating high-performance concrete; Assesses the major challenges of integrating carbon nanomaterials into concrete manufacture on an industrial scale.

An important new state-of-the-art report prepared by RILEM Technical

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Committee 108 ICC. It has been written by a team of leading international experts from the UK, USA, Canada, Israel, Germany, Denmark, South Africa, Italy and France. Research studies over recent years in the field of cement science have focused on the behaviour of the interfaces between the components of cement-based materials. The techniques used in other areas of materials science are being applied to the complex materials found in cements

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and concretes, and this book provides a significant survey of the present state of the art.

- Preface - Introduction - Organising Committee - Scientific and Technical Committee - Collaborating Institutions - Sponsoring Organisations with Exhibition - Exhibiting Organisations - Supporting Institutions - Opening paper
THEME 1 TECHNIQUES, INSTRUMENTATION AND MATERIALS
Keynote Paper - Micro-Damage Characterisation of Concrete Structures

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Based on Acoustic Emission - Scanning Probe Microscopy Techniques for the Study of Cementitious Materials as Nanoscale: Current Status and Challenges Ahead - Overview of Concrete Modelling - Size Effect in Nanoindentation of Cement Paste - Influence of Nano-Sized Mineral Additions on Performance of SCC

THEME 2
THEORETICAL MODELLING AND APPLICATIONS

Keynote Paper - Multi-Scale Modelling in Engineering Practice and Materials

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Research - A Vehicle for Progress -
Creating Bio-mimetic Microstructures in
Cement -A Preliminary Study - Effects
of Nanosilica Additions on Cement
Pastes - Nanostructural
Superplasticizers for In-Lining
Concrete in Underground Projects -
Theory of the Stress-Strain
Relationship of Concrete and Steel -
Closing Paper - Index of Authors -
Subject Index
The 3rd International Symposium on

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Nanotechnology in Construction (NICOM 3) follows the highly successful NICOM 1 (Paisley, UK 2003) and NICOM 2 (Bilbao, Spain 2005) Symposia. The NICOM3 symposium was held in Prague, Czech Republic from May 31 to June 2, 2009 under the auspices of the Czech Technical University in Prague. It was a cross-disciplinary event, bringing together R&D experts and users from different fields all with interest in nanotechnology and construction. The

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conference was aimed at: Understanding of internal structures of existing construction materials at nano-scale Modification at nano-scale of existing construction materials. Production and properties of nanoparticulate materials, nanotubes and novel polymers. Modeling and simulation of nanostructures. Instrumentation, techniques and metrology at nano-scale. Health and safety issues and environmental impacts related to

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nanotechnology during research, manufacture and product use. Review of current legislation. Societal and commercial impacts of nanotechnology in construction, their predictions and analysis.

Optimization, Characterization and Sustainable Application

20. Nanotechnology for eco-efficient concrete

New Materials in Civil Engineering
Progress in Nanotechnology

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Nanotechnology for Smart Concrete
Molecular Simulation on Cement-Based
Materials

This chapter discusses the development of a materials science approach with an application to nanotechnology to optimize the processing and micro/nanoscale structure of cement-based materials reinforced with nanosized fibers and carbon nanotubes. The dispersion of multi-walled carbon nanotubes (MWCNTs) and carbon nanofibers (CNFs) for use in cementitious composites and

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specifically the effect of ultrasonication energy are discussed in detail. The nanomechanical properties of the CNT/ CNF cementitious nanocomposites are examined through nanoindentation experiments. Additionally, the excellent reinforcing ability of both the MWCNTs and CNFs is demonstrated. Finally, the effect of the addition of silica nanoparticles on the degradation by calcium leaching is discussed and explained. This book is a collection of select papers presented at the Tenth Structural Engineering

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Convention 2016 (SEC-2016). It comprises plenary, invited, and contributory papers covering numerous applications from a wide spectrum of areas related to structural engineering. It presents contributions by academics, researchers, and practicing structural engineers addressing analysis and design of concrete and steel structures, computational structural mechanics, new building materials for sustainable construction, mitigation of structures against natural hazards, structural health monitoring,

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wind and earthquake engineering, vibration control and smart structures, condition assessment and performance evaluation, repair, rehabilitation and retrofit of structures. Also covering advances in construction techniques/ practices, behavior of structures under blast/impact loading, fatigue and fracture, composite materials and structures, and structures for non-conventional energy (wind and solar), it will serve as a valuable resource for researchers, students and practicing engineers alike.

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Nanotechnology in the Automotive Industry explores how nanotechnology and nanomaterials are used to enhance the performance of materials and devices for automotive application by fabricating nano-alloys, nanocomposites, nano coatings, nanodevices, nanocatalysts and nanosensors. Consisting of 36 chapters in 6 parts, this new volume in the Micro and Nano Technologies series is for materials scientists, nanotechnologists and automotive engineers working with nanotechnology and

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nanomaterials for automotive applications. Nanotechnology is seen as one of the core technologies for the future automotive industry to sustain competitiveness. The benefits that nanotechnology brings to the automotive sector include stronger and lighter materials for increased safety and reduced fuel consumption, improved engine performance and fuel consumption for gasoline powered vehicles due to nanocatalysts, fuel additives and lubricants, and more. Discusses various approaches and

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techniques such as nanoalloys, nanocomposites, nanocoatings, nanodevices, nanocatalysts and nanosensors used in modern vehicles Presents the challenges and future of automotive materials Explores how nanotechnology and nanomaterials are used to enhance the performance of materials and devices for automotive applications

Biopolymeric Nanomaterials: Fundamentals and Applications outlines the fundamental design concepts and emerging applications of biopolymeric nanomaterials. The book also

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provides information on emerging applications of biopolymeric nanomaterials, including in biomedicine, manufacturing and water purification, as well as assessing their physical, chemical and biological properties. This is an important reference source for materials scientists, engineers and biomedical scientists who are seeking to increase their understanding of how polymeric nanomaterials are being used for a range of biomedical and industrial applications. Biopolymeric nanomaterials refer to

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biocompatible nanomaterials, consisting of biopolymers, such as protein (silk, collagen, gelatin, β -casein, zein, and albumin), protein-mimicked polypeptides and polysaccharides (chitosan, alginate, pullulan, starch, and heparin). Biopolymeric nanomaterials may be used as i) delivery systems for bioactive compounds in food application, (ii) for delivery of therapeutic molecules (drugs and genes), or for (iii) tissue engineering. Provides information on the design concepts and synthesis of biopolymeric nanomaterials in

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biomedical and industrial applications

Highlights the major properties and processing methods for biopolymeric nanomaterials Assesses the major challenges of producing biopolymeric nanomaterials on an industrial scale

Biodegradation and Biodeterioration at the Nanoscale

Structure and Performance of Cements, Second Edition

Nanotechnology in Civil Infrastructure

Nanomaterials Recycling

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Properties, Modelling and Applications
Principles and Practices

Nanotechnology in Civil Infrastructure is a state-of-the art reference source describing the latest developments in nano-engineering and nano-modification of construction materials to improve the bulk properties, development of sustainable, intelligent, and smart concrete materials through the integration of nanotechnology based self-sensing and self-powered materials and cyber infrastructure technologies, review of nanotechnology applications in pavement engineering,

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development of novel, cost-effective, high-performance and long-lasting concrete products and processes through nanotechnology-based innovative processing of cement and cement paste, and advanced nanoscience modeling, visualization, and measurement systems for characterizing and testing civil infrastructure materials at the nano-scale. Researchers, practitioners, undergraduate and graduate students engaged in nanotechnology related research will find this book very useful.

Transportation Research Record: Journal of the Transportation Research Board, No. 2142 includes 20 papers that report on a laboratory

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study of a self-healing cementitious composite, nanocement enhancement of reactive powder concrete, nanocellulose and microcellulose fibers, nanotechnology to manipulate mortar performance, and an exploratory investigation of nanomaterials. This issue of the TRR also examines nanoporous thin film technology, calcium silicate hydrate, molecular dynamics of hydrated cement, carbon nanofibers and nanotubes in cementitious composites, nanoengineering ultra-high-performance concrete, and a road map for research for nanotechnology-based concrete materials. As the environmental impact of existing

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construction and building materials comes under increasing scrutiny, the search for more eco-efficient solutions has intensified. Nanotechnology offers great potential in this area and is already being widely used to great success. Nanotechnology in eco-efficient construction is an authoritative guide to the role of nanotechnology in the development of eco-efficient construction materials and sustainable construction. Following an introduction to the use of nanotechnology in eco-efficient construction materials, part one considers such infrastructural applications as nanoengineered cement-based materials,

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nanoparticles for high-performance and self-sensing concrete, and the use of nanotechnology to improve the bulk and surface properties of steel for structural applications. Nanoclay-modified asphalt mixtures and safety issues relating to nanomaterials for construction applications are also reviewed before part two goes on to discuss applications for building energy efficiency. Topics explored include thin films and nanostructured coatings, switchable glazing technology and third generation photovoltaic (PV) cells, high-performance thermal insulation materials, and silica nanogel

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for energy-efficient windows. Finally, photocatalytic applications are the focus of part three, which investigates nanoparticles for pollution control, self-cleaning and photosterilisation, and the role of nanotechnology in manufacturing paints and purifying water for eco-efficient buildings. Nanotechnology in eco-efficient construction is a technical guide for all those involved in the design, production and application of eco-efficient construction materials, including civil engineers, materials scientists, researchers and architects within any field of nanotechnology, eco-efficient materials or the construction

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industry. Provides an authoritative guide to the role of nanotechnology in the development of eco-efficient construction materials and sustainable construction Examines the use of nanotechnology in eco-efficient construction materials Considers a range of important infrastructural applications, before discussing applications for building energy efficiency Drawing together a multinational team of authors, this second edition of Structure and Performance of Cements highlights the latest global advances in the field of cement technology. Three broad categories are covered: basic materials and methods, cement

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extenders, and techniques of examination. Within these categories consideration has been given to environmental issues such as the use of waste materials in cement-burning as supplementary fuels and new and improved methods of instrumentation for examining structural aspects and performance of cements. This book also covers cement production, mineralogy and hydration, as well as the mechanical properties of cement, and the corrosion and durability of cementitious systems. Special cements are included, along with calcium aluminate and blended cements together with a consideration of the role of

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gypsum in cements. Structure and Performance of Cements is an invaluable key reference for academics, researchers and practitioners alike. Smart Nanoconcretes and Cement-Based Materials

Recent Advances in Structural Engineering, Volume 1

Proceedings of NICOM5

The Next Big Thing is Small : Session at the ACI Fall 2009 Convention, New Orleans, Louisiana, USA, 8-12 November 2009

Nanotechnology in Cement-Based Construction

Nanotechnology has already demonstrated surprising potential for improving the

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performance of construction materials and many of these recent developments were facilitated by NICOM symposia. The NICOM5 proceedings will cover the emerging opportunities and future use of nanotechnology in construction and will illustrate the broad potential for application of nanotechnology to challenging problems involving materials and infrastructure.

Nanotechnology for Civil Infrastructure:
Innovation and Eco-efficiency of
Nanostructured Cement-Based Materials

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explores recent innovations in civil infrastructure materials developed through nanotechnology. The book covers cementitious materials containing nanomaterials, covering their design, characterization and applications. The book also covers the possibilities to optimize properties such as rheological properties, mechanical strength, durability and resistance to aggressive environments and loads, and eco-efficiency. Final sections explore the integration of nanomaterials in cement

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mixtures that lead to nanocomposites with novel properties, such as self-healing, self-sensing, and self-cleaning, and featured applications in civil infrastructure. Describes the design and characteristics of high-strength and ultra-high performance cementitious materials that use nanomaterials Explores the relationship between nanostructure and materials performance Discusses the major civil engineering applications of nanomaterials

Concrete is now the material of choice for

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the construction of structures exposed to extreme conditions. However, conventional concrete suffers from a number of inherent deficiencies, such as its low tensile strength. As a result, concrete structures undergo significant shrinkage cracking. Recent studies have explored the use of nanotechnology and nanomaterials for enhancing the performance of cement paste, to solve this problem. Smart Nanoconcretes and Cement-Based Materials explores the fundamental concepts and applications of smart nanoconcretes with self-healing,

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self-cleaning, photocatalytic, antibacterial, piezoelectrical, heating and conducting properties which are used in the modern structures of high-rise buildings, hydraulic engineering, highways, tunnels, bridges. This book is an important reference source for both materials scientists and civil engineers who are looking to enhance the properties of smart nanomaterials to create stronger, more durable concrete.

A recent initiative within the civil engineering field is the use of

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nanotechnology and materials within the construction industry. While there has been great success in the adoption of various nanomaterials, there is still room for development and improvement. Advanced Research on Nanotechnology for Civil Engineering Applications highlights emergent research and theoretical concepts in the implementation of nanotechnology within the construction, geotechnical, and transportation engineering fields. Examining the application of nanomaterials, current trends within the

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topic area, and the potential health impacts of material usage on the environment, this book is a pivotal reference for professionals, engineers, students, and researchers.

Interfacial Transition Zone in Concrete
A Synopsis

Fundamentals and Applications

Biopolymeric Nanomaterials

Nanotechnology in Fuel Cells

Cement Industry

Nanotechnology in Concrete Materials A

Synopsis Nanotechnology in Cement-Based Construction CRC

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Press

A fundamental part of modern technology is composed of devices that use special materials as main components. Since the last few decades of the last century and even more recently, a remarkable development has been achieved in new micro- and nanostructured materials with compositional structures and production methods that open unprecedented technological, economic, and ecological perspectives due to high yields, economies of scale, the possibility of reducing weight and size, and the low environmental impact of the equipment that contains them. This book offers a collection of excellent studies that use state-of-the-art methodologies developed by professional researchers from different countries in diverse areas of materials. In this way, this book

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is particularly useful to academics, scientists, practicing researchers, and postgraduate students whose work relates to the latest nanomaterial technologies.

Nanomaterial Recycling provides an update on the many benefits nanomaterials can provide on both environmental and economic issues. Sections cover the appropriate recycling strategies of nanowastes, nanowaste regulations (including nanowaste disposal and recycling standards), promising applications (reuses) of these recycled nanomaterials, and various methods used for the separation of nanoparticles, including (i) centrifugation, (ii) solvent evaporation, (iii) magnetic separation, (iv) using pH/thermal responsive materials, (v) molecular antisolvents, (vi) nanostructured colloidal solvents, and more. This book is an

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important reference source for materials scientists and engineers who are seeking to increase their understanding of nanomaterials, recycling processes and techniques. As nanomaterials can be recycled from both new/pure products (from nano manufacturing) and used products (nano waste: waste from nano integrated products), this book is a welcomed addition to many disciplines. Provides information on how nanoscale recycling techniques can mitigate the most hazardous effects of nanomaterials Explains the major recycling processes and techniques used for nanoscale materials Assesses the major challenges of implementing nanoscale recycling approaches in a scalable and cost-effective manner

H F W Taylor was for many years Professor of Inorganic

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Chemistry at the University of Aberdeen, Scotland. Since 1948, his main research interest has been the chemistry of cement. His early work laid the foundations of our understanding of the structure at the nanometre level of C-S-H, the principal product formed when cement is mixed with water, and the one mainly responsible for its hardening. Subsequent studies took him into many additional aspects of the chemistry and materials science of cement and concrete. His work has been recognized by Fellowships and by other honours and awards from many scientific societies in the UK, USA and elsewhere. This second edition of Cement chemistry addresses the chemistry and materials science of the principal silicate and aluminate cements used in building and Civil engineering. Emphasis throughout is on the

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underlying science. The book deals more specifically with the chemistry of Portland cement manufacture and the nature of the resulting product, the processes that occur when this product is mixed with water, the nature of the hardened material, the chemistry of other types of hydraulic cement, and chemical and microstructural aspects of concrete, including processes that affect its durability. Since the first edition of this book was published in 1990, research throughout the world has greatly augmented our knowledge in all of these areas. The present edition has been updated and revised to take account of these advances. The reader will acquire a solid understanding of the subject and will be better equipped to deal with the problems and pitfalls that can arise in engineering practice as a result of inadequate

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understanding of the relevant chemistry. It will serve both as an introduction to those entering the subject for the first time and as a guide to the latest developments for those already experienced in the field.

A Paradigm Shift

Nanotechnology in Paper and Wood Engineering

Nanotechnology

Carbon Nanotubes and Carbon Nanofibers in Concrete—Advantages and Potential Risks

Advances in Protection, Repair, and Upgrade

Nanotechnology for Civil Infrastructure

The book presents original work on how nanomaterials are applied to concrete

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through electromutagenic processes, which modify the microstructure of concrete materials in situ without changing their dimensions or appearance. In essence, it shows how high-performance concrete can be mixed without expensive additives. The book offers a method for dispersing nanoparticles in concrete and explains how their presence reduces porosity, increases strength and prevents cracking-information that can be used

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for more efficient repair and rehabilitation. Nanomaterials are shown to improve barrier-formation, anti-corrosiveness, and other functions of concrete. Extensive practical guidelines are given on formulation, set-up, mixing, and testing. As a paradigm for the future, micro-scale technology seeks to fuse revolutionary concepts in science and engineering and then translate it into reality. Nanotechnology is an

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interdisciplinary field that aims to connect what is seen with the naked eye and what is unseen on the molecular level. The Handbook of Research on Diverse Applications of Nanotechnology in Biomedicine, Chemistry, and Engineering examines the strengths and future potential of micro-scale technologies in a variety of industries. Highlighting the benefits, shortcomings, and emerging perspectives in the application of nano-scale

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technologies, this book is a comprehensive reference source for synthetic chemists, engineers, graduate students, and researchers with an interest in the multidisciplinary applications, as well as the ongoing research in the field.

Covering the latest technologies, Nanotechnology in eco-efficient construction provides an authoritative guide to the role of nanotechnology in the development of eco-efficient

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construction materials and sustainable construction. The book contains a special focus on applications concerning concrete and cement, as nanotechnology is driving significant development in concrete technologies. The new edition has 14 new chapters, including 3 new parts: Mortars and concrete related applications; Applications for pavements and other structural materials; and Toxicity, safety handling and environmental

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impacts. Civil engineers requiring an understanding of eco-efficient construction materials, as well as researchers and architects within any field of nanotechnology, eco-efficient materials or the construction industry will find this updated reference to be highly valuable. Addresses issues such as toxicity and LCA aspects New chapters covering safety handling on occupational exposure of nanoparticles and the assessment of personal exposure

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to airborne nanomaterials Discusses the effects of adding nano-particles on the durability and on the properties of geopolymers

New Materials in Civil Engineering provides engineers and scientists with the tools and methods needed to meet the challenge of designing and constructing more resilient and sustainable infrastructures. This book is a valuable guide to the properties, selection criteria, products,

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applications, lifecycle and recyclability of advanced materials. It presents an A-to-Z approach to all types of materials, highlighting their key performance properties, principal characteristics and applications. Traditional materials covered include concrete, soil, steel, timber, fly ash, geosynthetic, fiber-reinforced concrete, smart materials, carbon fiber and reinforced polymers. In addition, the book covers nanotechnology and

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biotechnology in the development of new materials. Covers a variety of materials, including fly ash, geosynthetic, fiber-reinforced concrete, smart materials, carbon fiber reinforced polymer and waste materials Provides a “one-stop resource of information for the latest materials and practical applications Includes a variety of different use case studies Innovation and Eco-efficiency of Nanostructured Cement-Based Materials

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Select Proceedings of SEC 2016

Cement Chemistry

Eco-efficient concrete

Nanotechnology in Cement and Concrete Processing

This edition of Progress in Ceramic Technology series contains a select compilation of articles on the topic of nanomaterials processing of powders; thin films, wires and tubes; and composites that were previously published in The American Ceramic Society Bulletin, Journal of the American Ceramic Society, International Journal of Applied Ceramic Technology, Ceramic Engineering and Science Proceedings

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(CESP) and Ceramic Transactions (CT).

Nanotechnology in Paper and Wood Engineering: Fundamentals, Challenges and Applications describes recent advances made in the use of nanotechnology in the paper and pulp industry. Various types of nano-additives commonly used in the paper industry for modification of raw material to enhance final products are included, with other sections covering the imaging applications of nano-papers and nano-woods in pharmaceuticals, biocatalysis, photocatalysis and energy storage. This book is an important reference source for materials scientists and engineers who are looking to understand how nanotechnology is being used to create more efficient

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manufacturing processes in for the paper and wood industries. Provides information on nano-paper production and its applications Explains the major synthesis techniques and design concepts of cellulosic or wooden nanomaterials for industrial applications Assesses the major challenges of creating nanotechnology-based manufacturing systems for wood and paper engineering

Many books on new smart materials are available, but specialized analysis of particular topics is still in high demand. This multiauthor book focuses on applying nanotechnology to cement-based materials to make numerous engineering applications possible. The addition of novel smart nanofillers allows the

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development of multifunctional composite materials, not just limited to improving mechanical strength, but also including several enhanced features. Special attention is devoted to types of nano-inclusions, novel techniques to mix components, and analysis of properties that can be achieved by paste, mortar, or concrete if added with nanofillers. Among these properties, the capability of self-sensing is very promising. Moreover, the use of phase-changing materials improves the energy efficiency of nanocomposites, resulting in important applications in engineering. Particular attention is also focused on energy harvesting and electromagnetic shielding properties. Comprehensive and up to date, this is an

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important reference book that not only provides in-depth information about recent developments and perspectives in this field but also discusses topics that promise major developments in the near future. This book presents a number of studies on the molecular dynamics of cement-based materials. It introduces a practical molecular model of cement-hydrate, delineates the relationship between molecular structure and nanoscale properties, reveals the transport mechanism of cement-hydrate, and provides useful methods for material design. Based on the molecular model presented here, the book subsequently sheds light on nanotechnology applications in the design of construction and

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building materials. As such, it offers a valuable asset for researchers, scientists, and engineers in the field of construction and building materials.

Proceedings of the NICOM3

Applications of Nanotechnology in Concrete Design Materials, Processes and Applications

Nanomaterials in Concrete

From Theory to Application

Cement Based Materials

Biodegradation and Biodeterioration at the Nanoscale describes the biodegradation and biodeterioration of materials in the presence of nanomaterials. The book's chapters focus on the basic principles, action mechanisms

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and promising applications of advanced nanomaterials, along with their integration with biotechnological processes for controlled degradation and deterioration of materials. In addition, the current research indications, positive or negative environmental impacts, legislation and future directions are also discussed. This book is an important reference source for researchers, engineers and scientists working in environmental remediation, biotechnology, materials science, corrosion and nanotechnology. Provides detailed coverage on how nano-biomaterials degrade and deteriorate

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Compares how different types of bionanomaterials decompose Explains how the priorities of bionanomaterials affect their deterioration rate

Cement-based materials have been used by humans nearly since the dawn of civilization. The Egyptians used lime and gypsum cement to bind their aggregate materials, mud and straw, resulting in bricks that are used for building their famous Egyptian pyramids (between 3000 and 2500 BC). Hydrated cement is a cement material bonded together with water and used for building construction; it is characterized by acceptable chemical,

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physical, thermal, mechanical, and structural stability. It plays a main role in the creation of vessels for storage, roads to travel on, weather-resistant structure for protection, inert hard stabilizer for hazardous wastes, and so on. Due to the composition of these materials and their advantages, it has been practiced in different applications. Cement is an essential component of making concrete, the single most prevalent building material used worldwide for construction, skyscrapers, highways, tunnels, bridges, hydraulic dams, and railway ties. Besides their numerous

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desired properties, there are some undesirable features. To overcome these disadvantages, several studies were established to prepare, improve, and evaluate innovative cement-based materials. Despite its oldness and deep research, every year several methods and materials evolve and so do cement technology. This book intends to provide a comprehensive overview on recent advances in the evaluation of these materials.

Over the past few years, concrete technology has advanced quite dramatically thanks to the use of a great variety of additives and

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admixtures, which have paved the way for the effective development of new-generation concrete mixtures. Among these additives and admixtures, nanomaterials used in construction materials such as paste, mortar, and concrete mixtures have become very popular recently. Much of the previous attention in regard to the utilization of nanomaterials in construction materials was specifically devoted to the characterization of their fresh-state, hydration, microstructure, pore structure, mechanical, transport, and durability properties. However, research into the tailoring of multi-

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functional properties of construction materials (especially cementitious) with the use of nanomaterials is still in its infancy. Recent Advances in Nano-Tailored Multi-Functional Cementitious Composites aims to capture recent major scientific advances and the current state of the art in multi-functional cementitious composites developed with nanomaterials. The book will provide researchers, engineers, and other stakeholders with an insight into future directions of multi-functional capabilities of cementitious composites. Chapters focus on the large-scale development,

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characterization, and application of multi-functional cementitious composites addressing the following topics: nano-modified concrete; strain-hardening cementitious composites; self-sensing concrete; self-healing and bacteria-based concrete; self-cleaning concrete; self-consolidating concrete; material/construction technology for 3D printing; thermal insulation capability; green concretes including geopolymers concrete; nanoscale characterization methods; low CO₂ reactive magnesia cements; and future developments and challenges of nano-tailored cementitious composites. The book will be an

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essential reference resource for academic and industrial researchers, materials scientists, and civil engineers working on the development and application of nano-tailored multi-functional cementitious composites. Provides very comprehensive and unique details about multi-functional properties of cementitious composites. Presents a detailed account of investigations conducted into the application of nanomaterials and nanoscale tailoring to achieve multi-functional properties for cementitious composites. Features state-of-the-art preparation, production, processing, and implementation

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techniques of nanoscale tailoring of multi-functional cementitious composites starting from laboratory to large scale.

Concrete is a macro-material strongly influenced by its nano-properties. The addition of nano particles to cement based materials can control the degradation of the calcium-silicatehydrate reaction caused by calcium leaching in water, blocking water penetration and leading to improvements in durability. Nano-sensors have a great potential to be used in concrete structures for quality control and durability monitoring. With nanomaterials increased

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material functionality, it may be possible in some cases to replace toxic materials and still achieve the desired functionality (in terms of electrical conductivity, material strength, heat transfer, etc.), often with other life-cycle benefits in terms of material and energy use.

Oppourtunities For Its Use In Concrete Industry

Nanotechnology in Construction

New Uses of Micro and Nanomaterials

Nano-Engineered Cementitious Composites

Nanotechnology in Eco-efficient Construction

Nanotechnology in Concrete Materials

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Cement is the basis of the building and construction industry and of fundamental importance for many civil engineering applications. As such, the cement industry is one of the key industries worldwide necessary for the current and future sustainable development of society. Despite its undisputed importance, the cement industry is one of those industrial branches predominately responsible for high energy consumption and excessive

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generation of large amounts of carbon dioxide and other contaminants that significantly endanger human health and the environment and contributes to global warming. In this context, nanomaterials, polymeric materials, and natural additives are being used for cement enhancement in various applications. This book examines these novel materials and their optimization, characterization, and sustainable application in the building industry

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and for stabilizing hazardous waste. The importance of nanotechnology related research and development has become recognised worldwide.

Substantial public and private investment is now being ploughed into research and development in a number of industrial sectors, where nanotechnology has become established and has led to new commercial products. The construction industry, having major economic significance with nano-scale

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research and development which is only emerging, offers a wide scope for exploitation of nanotechnology. With international contributions from experts in the field, Nanotechnology in Construction amalgamates previously fragmented research and emerging trends. It reflects the inherent multi-disciplinary nature of nano-scale research in construction and contributions cover a wide spectrum, from highly scientific investigations

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to futuristic applications. The book is organised into four broad sections, the first reviews and analyses the prospects of exploitation of nanotechnology in construction, the second discusses novel tools and their capabilities, the final two sections show existing significant products where nanotechnology has been already been exploited or where product development is under-way.

Nanotechnology in Construction will

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appeal to researchers already working in this field as well as those wishing to enter it. It will also inform governmental and other funding agencies of the most promising future directions and their related timescales. Practical applications are considered and explanations of the underlying basics are given, raising awareness and understanding of what nanotechnology can offer to construction professionals in general.

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This book presents the latest research advances and findings in the field of smart/multifunctional concretes, focusing on the principles, design and fabrication, test and characterization, performance and mechanism, and their applications in infrastructures. It also discusses future challenges in the development and application of smart/multifunctional concretes, providing useful theory, ideas and principles, as well as insights and

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practical guidance for developing sustainable infrastructures. It is a valuable resource for researchers, scientists and engineers in the field of civil-engineering materials and infrastructures.

This book focuses on civil engineering materials and nanotechnology.

Highlighting recent advances in the field of nano-engineered cementitious composites, it discusses their key principles, design and fabrication,

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testing and characterization, performance and mechanisms, as well as applications. Future developments and remaining challenges are also outlined. Nano-engineered cementitious composites are exceptionally strong, durable and offer multifunctional/smart performance that differs considerably from that of normal cementitious composites. Providing valuable insights into these composites' future development, the book offers an essential source of

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information, inspiration, theory and practical guidance for developing sustainable cementitious composites. As such, it will benefit researchers, scientists and engineers in the fields of civil engineering materials and nanotechnology alike.

Smart and Multifunctional Concrete
Toward Sustainable Infrastructures
Proceedings of the International
Conference Held at the University of
Dundee, Scotland UK on 7 July 2005

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Advanced Research on Nanotechnology for Civil Engineering Applications

Nanotechnology in the Automotive Industry

Nanotechnology of Concrete

Nanotechnology in Eco-Efficient Construction

Nanomaterials can markedly improve the mechanical properties of concrete, as well as reduce the porosity and enhance the durability of concrete. The application of nanotechnology in concrete is still in its infancy. However, an ever-growing demand for ultra-high-performance

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concrete and recurring environmental pollution caused by ordinary Portland cement has encouraged engineers to exploit nanotechnology in the construction industry. Nanotechnology for Smart Concrete discusses the advantages and applications of nanomaterials in the concrete industry, including high-strength performance, microstructural improvement, self-healing, energy storage, and coatings. The book Analyses the linkage of concrete materials with nanomaterials and nanostructures Discusses the applications of nanomaterials in the concrete industry, including energy storage in green buildings, anti-corrosive coatings, and inhibiting pathogens and viruses Covers self-

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healing concrete Explores safety considerations, sustainability, and environmental impact of nanoconcrete Includes an appendix of solved questions This comprehensive and innovative text serves as a useful reference for upper-level undergraduate students, graduate students, and professionals in the fields of Civil and Construction Engineering, Materials Science and Engineering, and Nanomaterials. Dr. Ghasan Fahim Huseien is a research fellow at the Department of Building, School of Design and Environment, National University of Singapore, Singapore. He received his PhD degree from the University of Technology Malaysia in

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2017. Dr. Huseien has over 5 years of Applied R&D and 10 years of experience in manufacturing smart materials for sustainable building and smart cities. He has expertise in Advanced Sustainable Construction Materials covering Civil Engineering, Environmental Sciences and Engineering. He has authored and co-authored 50+ publications and technical reports, 3 books, and 15 book chapters, and participated in 25 national and international conferences/workshops. He is a peer reviewer for several international journals as well as Master's and PhD students. He is a member of the Concrete Society of Malaysia and the American Concrete Institute. Dr. Nur Hafizah Abd

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concrete structural systems, advanced concrete technology (green concrete technology and fibre reinforced concrete), civil engineering materials, polymer composites, and bio-composites. Professor Dr. Jahangir Mirza has over 35 years of Applied Research and Development (R&D) as well as teaching experience. He has expertise in Advanced Sustainable Construction Materials covering Civil Engineering, Environmental Sciences and Engineering, Chemistry, Earth Sciences, Geology, and Architecture departments. He has been a Senior Scientist at the Research Institute of Hydro-Quebec (IREQ), Montreal, Canada since 1985. He has been a Visiting Research

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Professor for the Environmental Engineering program at the University of Guelph in Ontario, Canada since 2018. Nanotechnology in Fuel Cells focuses on the use of nanotechnology in macroscopic and nanosized fuel cells to enhance their performance and lifespan. The book covers the fundamental design concepts and promising applications of nanotechnology-enhanced fuel cells and their advantages over traditional fuel cells in portable devices, including longer shelf life and lower cost. In the case of proton-exchange membrane fuel cells (PEMFCs), nano-membranes could provide 100 times higher conductivity of hydrogen ions in low humidity conditions

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than traditional membranes. For hydrogen fuel cell, nanocatalysts (Pt hybrid nanoparticles) could provide 12 times higher catalytic activity. This is an important reference source for materials scientists and engineers who are looking to understand how nanotechnology is being used to create more efficient macro- and nanosized fuel cells. Outlines how fuel cells can be nanoengineered to enhance their performance and lifespan Covers a variety of fuel cell types, including proton-exchange membrane fuel cells and hydrogen-based fuel cells Assesses the major challenges of nanoengineering fuel cells at an industrial scale

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Recent Advances in Nano-Tailored Multi-Functional Cementitious Composites

Handbook of Research on Diverse Applications of Nanotechnology in Biomedicine, Chemistry, and Engineering

Fundamentals, Challenges and Applications